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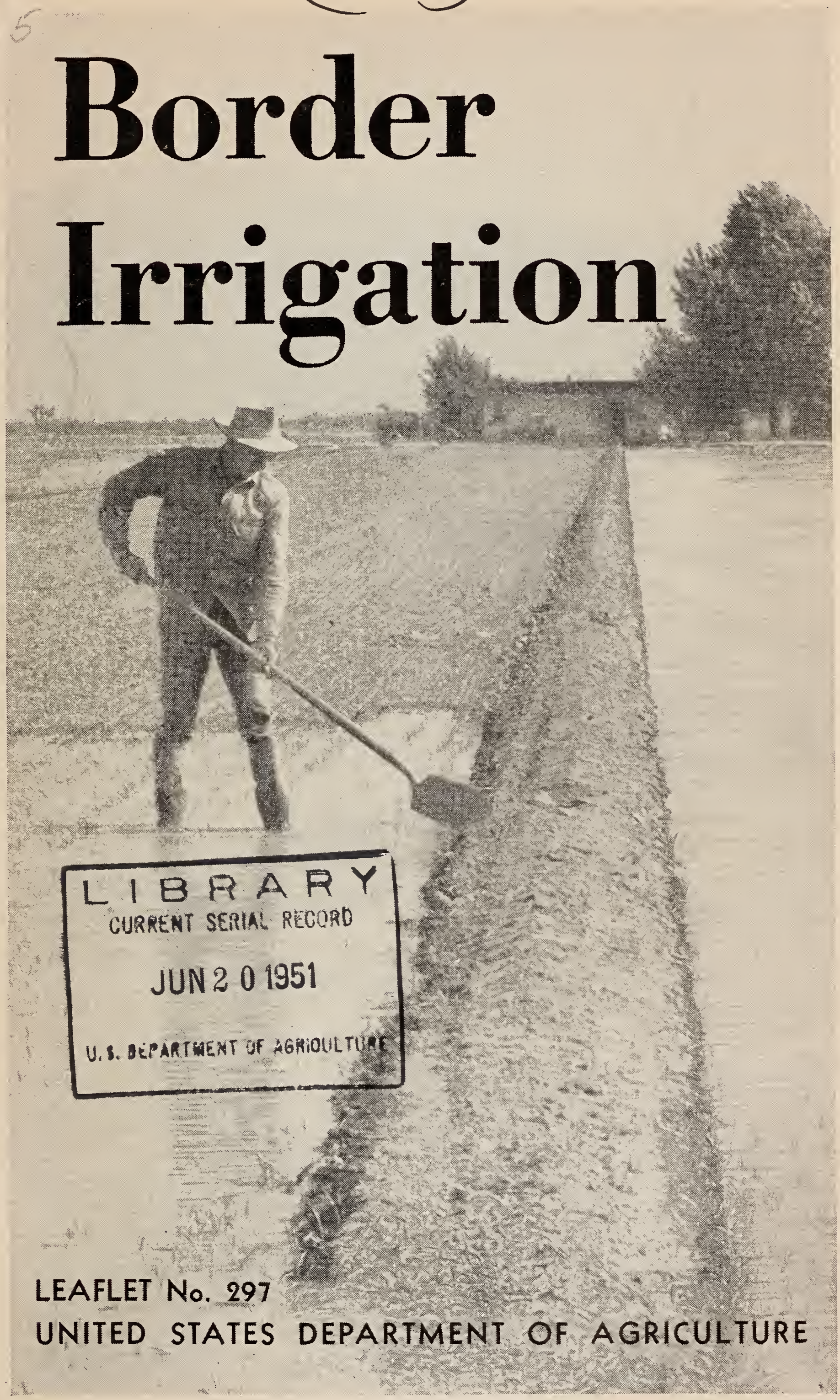
Border Irrigation



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BORDER IRRIGATION

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BORDER IRRIGATION is among the best methods for irrigating many crops on gentle slopes. It is an easy, economical, and efficient way to irrigate. You have excellent control of irrigation water at all times with a relatively small amount of labor. The method is widely used in "conservation irrigation."

Under the border system, fields are divided into strips between low ridges, or "borders." The width of the strips varies with the kind of soil, land slope, crops grown, and the amount of water available. Each strip is irrigated by advancing a sheet of water from one end to the other (fig. 1). One man can usually irrigate several strips between borders at the same time. An important advantage of the border system is the excellent water control which you have at all times.

Proper use of irrigation water results in better yields. Over-irrigation leaches plant food from the soil and may cause erosion and drainage problems. The results are lower yields and a lower value of your farm. Before selecting your irrigation method, consider the slope of the fields and the ability of the soil to absorb and hold water. Also, learn the depth your crops will root and the amount of water they need.

Several methods of applying irrigation water give good control. The method you select for your fields should be determined by your soil conditions. the slope of your lands, the amount of water you have, and the kind of crops your soils are capable of producing. Do not select a certain method just because your neighbors are using it. Make sure you select methods that fit the conditions on your farm.

WHEN TO USE THE BORDER METHOD

The border method of irrigation works best when:

1. The land is planted to crops not damaged by temporary flooding. These include close-growing crops such as pasture, grain, alfalfa, and flax. and some row crops and some orchards.
2. The soil is deep enough to allow needed grading.
3. The land can be economically graded to a ground slope of not more than 2 feet of fall in 100 feet of length, except where the land is to be in sod.
4. The soils do not have an extremely high or extremely low water-intake rate.
5. The irrigation water supply can be delivered at rates ample to meet the strip-size relations shown in table 1.

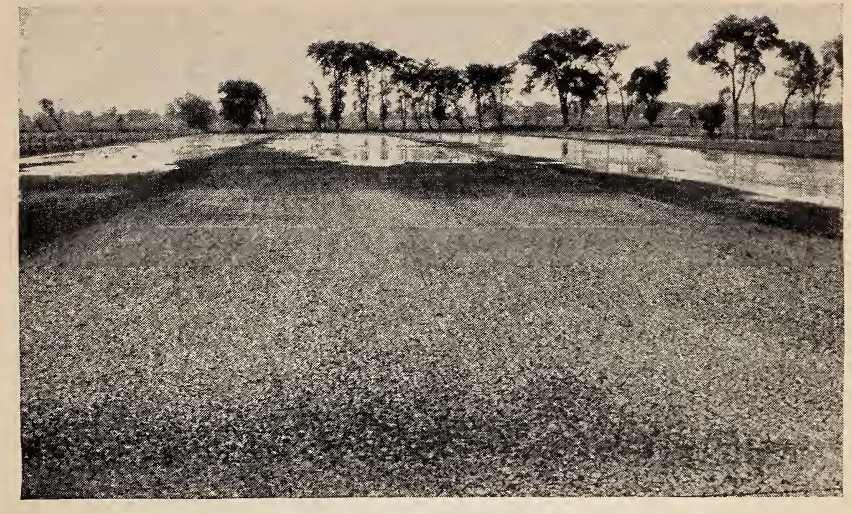

Figure 1.—**Border irrigation on gently sloping land.**

Before deciding on an irrigation system, examine the soil over your field. You need to know about the subsoil as well as the surface texture to select the irrigation method best adapted to your land.

You can examine the soil by digging pits or by taking soil samples with an auger. Or if you are in a soil conservation district you may get this information from the Soil Conservation Service technician assigned there.

Land Slope

For border irrigation, ground slopes should be fairly uniform so that grading costs will not be excessive. For best results, slope in the direction of irrigation should not be more than about 2 feet per 100 feet. On steeper grades, you will find it difficult to keep water spread over the width of a strip. More important, where grades are steeper, damaging soil erosion generally occurs in irrigating any crop except established sod. Permanent pasture established without irrigation, or established by sprinkling, may be irrigated on steeper slopes because the sod prevents erosion.

Grades of 6 to 12 inches per 100 feet are most satisfactory on light soils with rapid water intake. Grades of 1 or 2 inches per 100 feet are best on soils with low water-intake rate.

The strips, the land within the border ridges, are generally laid out in the direction of the steepest ground slopes. This takes the least leveling from side to side in each strip. The strips are sometimes laid out on the contour, across the slope at right angles to natural drainage (fig. 2). For easy operation the strip should be of uniform width throughout its length.

Soil

You can use the border method on soils that have a wide range of water-intake rates, but it is not practical where rates are either very high or very low.

Sandy soil irrigates much more quickly than heavy-textured soil because water soaks through the porous soil very rapidly, wetting the root zone in a

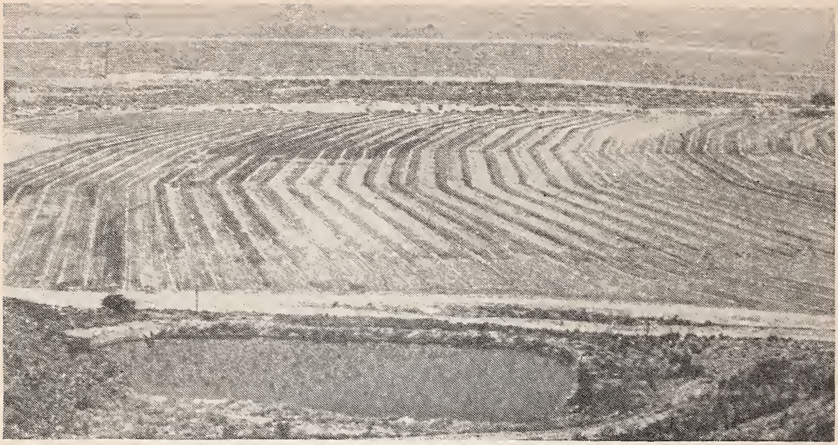

Figure 2.—**Irrigating in contour border strips.**

short time, perhaps an hour or less. On the other extreme, water moves slowly through the heavier soils, the clay loams and the clays. It takes several hours for the water to irrigate the root zone of such soils.

In soils with high intake rates, a large head of water is necessary for quick irrigation of small strips. In heavy soils, because of the low intake rate, a small rate of flow is sufficient. Rates of water delivery and sizes of strips shown in table 1 generally allow irrigation of crops of average rooting depth without excessive waste of water by deep percolation below the root zone. In deep soils the mass of roots will usually be in the top 2 to 5 feet of soil, depending on the crop. In shallow soils, most plants use the whole depth of the soil. You need to irrigate only as deep as the roots go.

Irrigation engineers consider all these factors in planning border-irrigation systems. You can recognize the broader relations of crops, land, soil, and water supply. If your farm is in a soil conservation district, you can get technical assistance for your border-system design from Soil Conservation Service technicians in your district. They will help you plan and lay out your border-irrigation system.

SIZE OF THE STRIPS

The lengths of strips given in table 1 are as long as practicable for efficient water control. Strip widths and rates of water delivery are in the range commonly found practical. Width may be varied in direct proportion to change in rate of flow. For slopes of more than 1 percent, however, strip width usually should be narrower than the minimum width shown. For permanent pastures, strips are often made 12 to 15 feet wide.

The minimum practical strip width depends on the width of the farm machinery you use. You will want the border ridges far enough apart to allow operation of machinery within each strip. Where drills or planters are to be used, the width of the strip should be some multiple of the width of the machine.

Consider these factors and plan your border lay-out before doing any land grading. It will save earth moving.

TABLE 1.—*Size of strips*

Water-intake rate and soil texture (uniform soil profile)	Rate of flow per strip[1]	Width[2]	Maximum length	Average area
	Cubic feet per second	*Feet*	*Feet*	*Acres*
Very high:[3]				
Coarse texture (sand)	2½	20	200–300	0.1
High:				
Light texture (sandy loam)	1½–2½	20–30	300–400	.2
Moderate:				
Medium texture (silt loam)	1–2	20–40	400–700	.4
Low:				
Heavy texture (clay loam)	½–1½	20–50	700–1,000	.7
Very low:[3]				
Very heavy texture (clay)	½–1	20–50	700–1,300	1.0

[1] Approximate equivalent rates of flow: 1 cubic foot per second=450 gallons per minute; 1 cubic foot per second=40 or 50 miner's inches, depending on the State.

[2] Generally satisfactory for such crops as alfalfa. Borders for permanent-pasture irrigation are often as narrow as 15 feet, or even less.

[3] The border method may be used but other methods may be better adapted.

CONSTRUCTION

Land Leveling

You should complete all field grading, commonly called "leveling," before you build the border ridges or install the water distribution system. Grade the field uniformly in the direction of irrigation and reduce the cross slope, at right angles to the direction of irrigation, as much as is practical. Any cross slope remaining between the ridges after the general field grading will have to be removed in the final grading of each strip. Accurate grading is essential, to avoid crop damage by prolonged ponding and to keep the shallow flow spread over the entire surface of the strip.

Grading is commonly done with any of many commercial earth movers or small farm scrapers. Final smoothing can be done with a land plane leveler or a float.

Border Ridges

After you have completed general field grading, construct the ridges that make the borders of each strip. The ridges

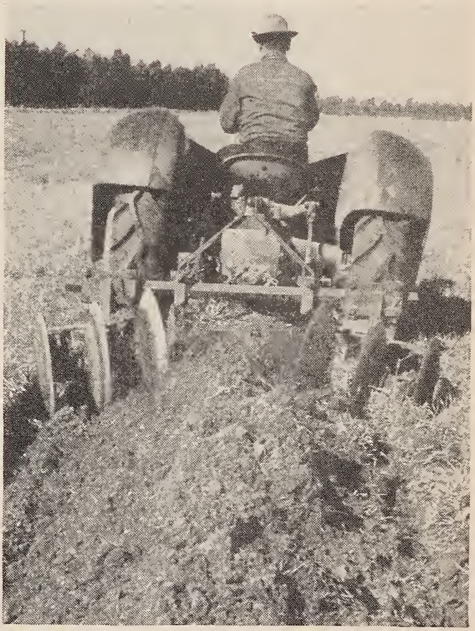

Figure 3.—**Constructing ridges with a border disk.**

should be no higher than necessary to hold the water. Tops of border ridges that are higher than necessary may not get enough water for uniform crop growth. In well-graded fields, settled height of ridges should be about 4 inches on soils with very low water-intake rates. They should be about 10 inches on soils having very high intake rates.

The border ridges may be built with several types of equipment. Border disks (fig. 3) or border drags, which will build a high enough ridge for most conditions, are commonly used.

You can build a border drag (fig. 4) in a short time. Use 2- or 3-inch by 12-inch planks, 12 or 14 feet long, for the runners. The bracing should be 2- by 6-inch material, securely spiked and rigidly fastened to hold the runners vertical. The front width between runners should be about 10 feet and the rear spacing 2 feet. Larger equipment is also common (fig. 5).

You can also construct good border ridges with a scraper, working across the field and dumping at each border location. Graders, though less common, do an excellent job of both border-ridge building and strip leveling.

Strip Grading

When border ridges have been built, finish grading from side to side in each strip, filling any low points and cutting high points so that the entire strip will be wetted without ponding. From side to side in each strip, grade the soil to within an inch of level so water will spread uniformly over the entire width. Wide strips and heavy soils require more exact grading. Floats, buck scrapers, or graders are often used for this operation. Be sure to fill any ditches formed in building the border ridge.

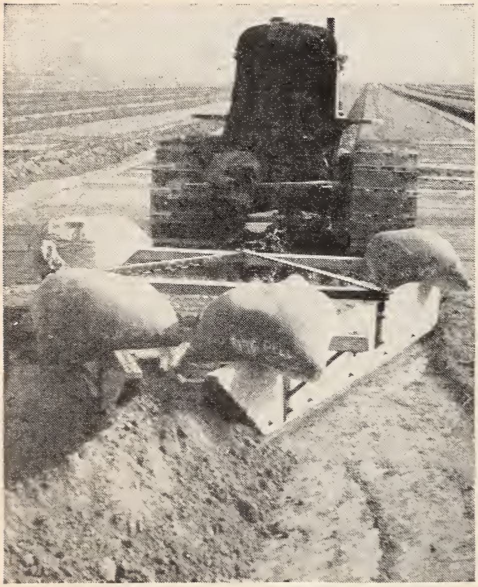

***Figure 4.*—A border drag.**

When you think final grading is completed, run water down each strip to check the grading job. High and low spots will be apparent and should be marked for further cut and fill after the ground has dried. When the soil has dried, complete final grading. Round off the border ridges with a harrow if they are to be seeded, or drill across them to give them a workable shape. Don't try to "wet level." The mud stirred up and the soil compaction often seal the soil, preventing uniform penetration of water and uniform crop growth. Border ridges may be ended a short distance from the lower side of the field to leave a smooth strip across the end of the field for turning equipment. This area will get irrigated without ridges.

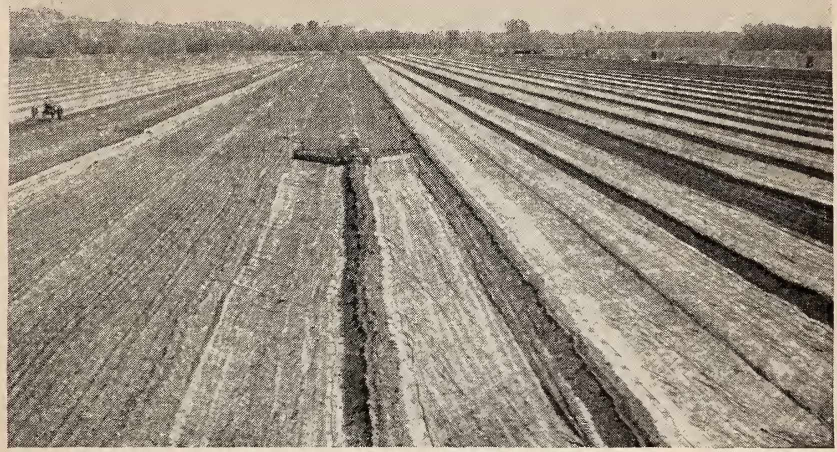

Figure 5.—**Constructing ridges with a border drag.**

WATER SUPPLY AND DISTRIBUTION

One of the requirements for use of the border method of irrigation is a relatively high rate of water delivery, often termed a "big head" of water. Within a limited range, strip width may be reduced in direct proportion to reduction in rate of flow to fit a smaller water supply than shown in table 1. Practical operation of farm equipment limits this reduction in width. The water-supply system must deliver enough water to irrigate at least one strip at a time. When water is delivered at low rates, the needed irrigation heads can be built up by using a holding reservoir.

Types of distributing systems vary considerably with the intensity of agriculture, crop values, water costs, kind of soil, farm equipment used, and other factors. Probably the most satisfactory, from the standpoint of farm operation, are buried pipelines with an outlet valve in each strip. Minimum water loss by conveyance occurs with this system and lines do not have to be laid on grade. No land is taken out of cultivation and there are no weed strips to keep clean.

Earth ditches are the cheapest means of conveyance on gentle slopes and are satisfactory on medium- and heavy-textured soils. They should be uniformly graded and on gentle slopes that will not cause scouring velocities of flow in the ditch. Ditches require outlet pipes or turn-out boxes into each strip. Grade-control structures and division boxes may also be necessary, depending on the ditch lay-out. Portable surface pipe and wooden flumes are also used in some places to distribute water from a central main ditch or pipeline. Field head ditches are not necessary when the water is distributed in this manner.

All water outlets into strips should be installed so as to allow good control and even division of flow between strips. They should be set low enough to avoid washing a hole as water enters the strip.

WASTE-WATER DISPOSAL

With the approximate strip lengths indicated in table 1, a good irrigator should get a minimum of waste water. On heavy soils, you should provide graded ditches for drainage of waste water. It should be drained off the land within a day to prevent crop damage by flooding. Waste-water disposal systems are seldom necessary on sandy soils because water soaks into the ground quickly.

EFFECT OF BORDER IRRIGATION ON FARM OPERATIONS

When field grading involves deep fills, the filled areas will settle considerably during the first year of irrigation. This requires some additional grading after the first irrigation season. It is, therefore, desirable to plant an annual crop the first year after grading, followed by regrading within the strip before planting to another annual or to a perennial crop.

When the field is planted to a close-growing crop, the ridges should be seeded with the strips. Drills are commonly operated across both the strips and the ridges. Ridges can be harrowed to shape them for easier mowing and crossing with all types of equipment. On pastures irrigated by the border method (fig. 6), stock will trail on the ridges if the field is grazed when too wet. Allow time for strips to dry after irrigation before turning in stock.

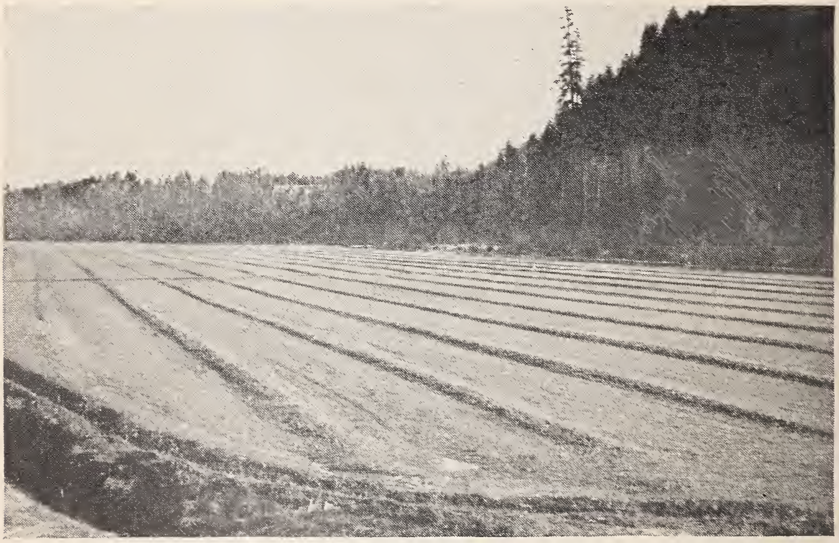

Figure 6.—**Border-irrigated pasture with good growth of grass over the entire area.**

Well planned, adequately constructed, and on adapted land, the border method makes possible efficient and economical irrigation. Your use of good irrigation practices will determine the actual results attained.

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